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Reclamation of Agricultural Land by Diking

Civil Engineering
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1905

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RECLAMATION
OF
AGRICULTURAL LAND
BY
DIKING

BY

CLEVES HARRISON HOWELL

THESIS

FOR

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

PRESENTED JUNE 1905

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

CLEVES HARRISON HOWELL

ENTITLED RECLAMATION OF AGRICULTURAL LAND BY DIKING

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Civil Engineering

Ira O. Baker.

HEAD OF DEPARTMENT OF Civil Engineering

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Statement of the Problem

The tract of land under consideration lies on the south bank of the Illinois river adjoining Beardstown on the southwest. It comprises nine thousand acres which are subject to the annual overflow of the river. The soil is about 4 feet of river silt upon a deep stratum of sand.

This tract is cut up by the narrow and deep "lakes" or bayous running north and south, and having an outlet near the south end of the land. About one mile south of this outlet a stream called Indian Creek runs into the river. A highway runs from Beardstown southwestward about two miles southeast of the river. The land to the south of this highway is nearly in channels and drains away from the loamy land on the north. The road runs

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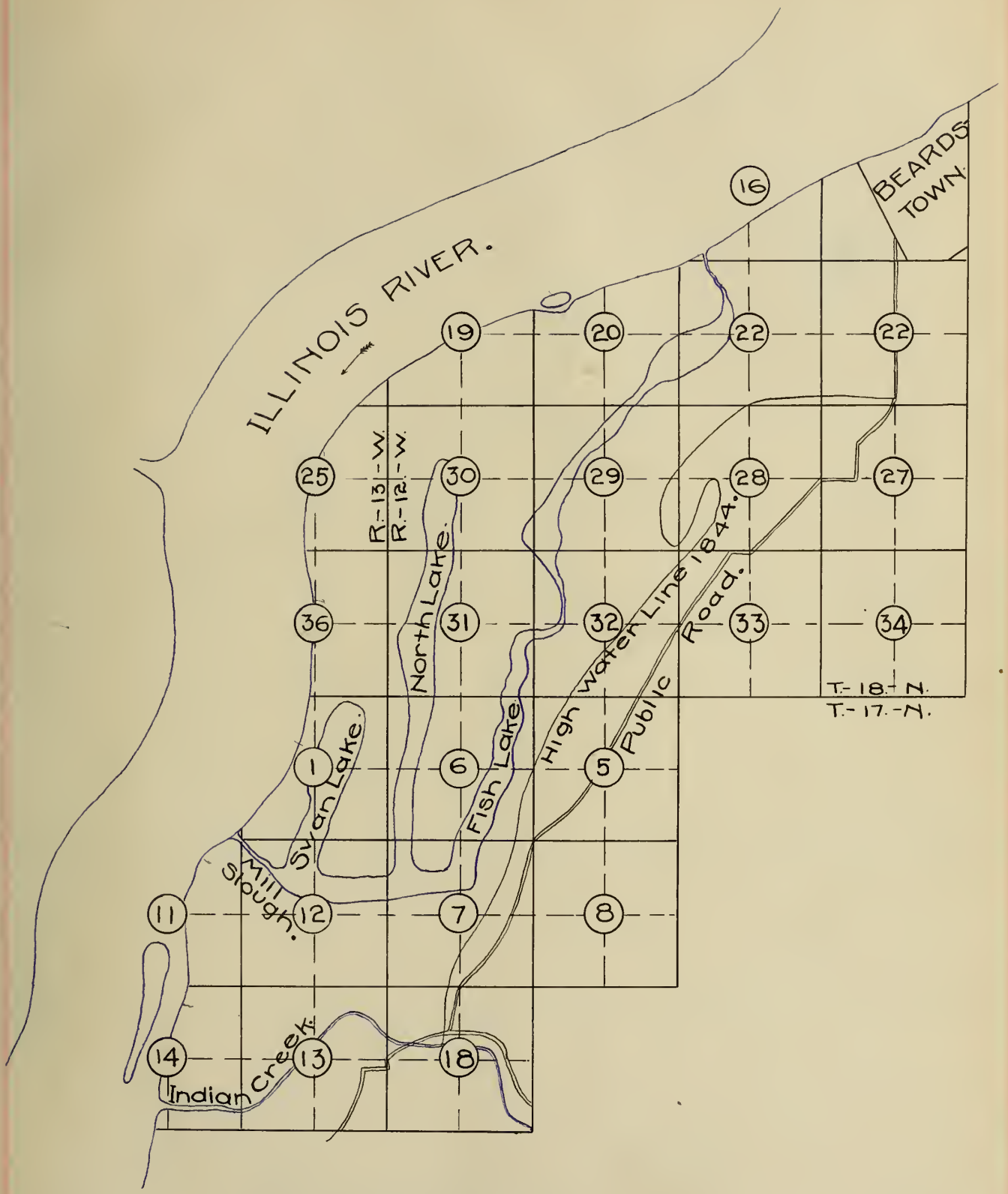
on the edge of the salt deposit. The difference between the two soils is very noticeable along this highway. On the right as one approaches Bonneville the soil is very sandy, on the left it is entirely free from sand. So marked is this characteristic that if a handful of the latter soil is rubbed between the hands not the least trace of sand is noticed.

The proposition is to reclaim this land for agriculture by building a levee to guard the river from overflowing it and to drain it by means of pumps and ditches.

Discussion of Engineering Problem

Geological Features. This individual tract of land owes its existence in its present form to the tendency of silt bearing streams to fill up the beds by the sediment they carry.



Scale 1 inch = 1 mile.

and as a result new channels are constantly forming offering easier access to the mouth than the previous ones which are choked with silt; these in time large areas become covered with deposit, and left by the waters of the river the levelling action of rain and wind tend to fill up still more completely until once even the channels until we have an area of comparatively level land cut up sometimes, as in this case, by the dwindling remains of the sometime channels. On this tract the deposit is from three to four feet thick of the blackish silt.

Topographic and Hydrographic Conditions

These can best be understood by a reference to the map on page 3. The three "lakes" or bayous of themselves furnish natural drainage ditches.

Swan Lake is about fifteen feet deep throughout. North Lake is about the same depth to the middle of Section 31, and Fish Lake has also considerable depth up to the narrow portion in Section 32.

The average level of the bank is about 10 feet above the normal stage of the water or bottom plain. From the top of this bank the ground slopes slightly towards the highway, so that the drainage of the adjoining lands will not enter into consideration.

The Illinois River at low water runs slowly by this tract of land and what current there is is diminished by "backwater" when the river is high, this being the only time when the levees are under pressure the consideration of the "scour" can therefore be neglected.

Plan for Reclamation.

It is proposed to construct a levee along the river bank and along the north side of Indian Creek to the highway. The three lakes Swan, North and Fish will not be drained but will be left to serve as drainage ditches. A system of lateral ditches will be dug leading into the several lakes. A pumping station will be established to remove the rainfall and seepage. Ten miles of levee will be required, judged by experience on similar works the main section should be about 4 feet wide on top with slope of 3 to 1 on the river side and 2 to 1 on the land. To safely clear the crest of the highest water known, that of 1844, the levee should be 12 feet high above the bank. This height would give a levee 14 feet thick at the high water mark.

Such levees as long as there it would be economical to construct them by a floating dredge. However while the dredge is being built or launched, if it be not built on the spot, time could be gained by constructing the levee three or four feet perhaps by slip-scraper and dredging to cut the land at once, so the time high-water shown would not occur any year. Afterwards when the dredge was completed the remainder of the levee could be completed by building out the dredged bank until the desired height was reached, this method would give a better levee than by constructing it all at once as the lower portion would have time to consolidate and form a sort of a gradual wall in the bottom of the levee.

By this means it would

be possible to make an
the investment somewhat cheaper
than if no extension was
done until the frame had
been completed. The method
of construction with the dogs
would be. to float it in a
borrow pit. on the river side
of the levee and work for
the required height allowing the
levee to assume its natural
cross section. Because in work
of this kind it has been found
much cheaper to do this than
to work for the theoretical
cross section. This makes
a rough looking job but
the levee is a good deal stronger.
This method of course requires
more material than would be
called for in the theoretical
cross section but it is really
cheaper for the contractor to
handle the increased amount
of earth than it is for him to
obtain the theoretical cross section

and therefore the work should be paid for according to the amount in the specification.

The dredger should have a boom long enough to reach from the bottom of the borrow pit to the centre line of the levee, this requires a boom much longer than those ordinarily in dredges, the one used on the levee built by Chinn and Sons across the river for this work had a boom 85 feet long and one of about the same length would be required here.

This dredge has a dipper capacity of 2½ cubic yards and with an efficient crew handled on an average 50000 cubic yards a month.

The theoretical quantity of earth in the levee of about length and cross section is 800 000 cubic yards although as it would be constructed

it would probably have in excess of a million on account of the method of conduction before referred to. At present prices and condition. the lines could be constructed under contract for 12 cents a cubic yard, the contractor furnishing the dredge.

For the proper fill of the distance the borrow pit would be separated from the new slope by a tongue of land, this of course diminishes the acreage reclaimed, but when overgrown with trees and brush it would afford a very good protection to the levee which would compensate for the loss in land.

Methods of Dredging

The most feasible method which suggests itself is to utilize the three large lakes (as shown on map page) as dredging ditches

and from them run small open ditches or laterals. A pump station will be necessary to remove the water collected by the main and laterals. Several shallow mains should be dredged to shorten the length of these laterals and facilitate the drainage.

The mains should be about 10 feet deep and 25 feet wide on the bottom, experience with the ditches in the land reclaimed by Chinese and Japanese shows that this soil will stand with quite steep slopes, in this land they have no trouble with ditches having slopes of 2 to 1, and the same slopes could be safely used here. The small lateral ditches will be about 4 feet wide on bottom with slopes the same as in the larger ones.

At proper times the main ditches could be excavated

at 8 cents per cubic yard and the lateral ditches at 11 cents, it is estimated that there will be 150000 cubic yards in the mains and 100000 in the laterals. A certain amount of tiling will be necessary to properly bring the land to its highest efficiency.

The natural sight for the pumping station is on the north side of Mill Street, the outlet of the lake aforesaid.

Experience on the Chaney and Lowe's land before referred to, shows that not over 100 days pumping are necessary during the year with pumps having a capacity of 30000 gallons a minute, and on this land the number of days pumping can be reduced probably 10 percent or more on account of the water on the land back of it draining away from it as is not the case across the river where it was necessary to construct an intercepting ditch.

to handle the water from the highlands behind.

For many obvious reasons centrifugal pumps will be selected, two 15 inch and one 24 inch Morris centrifugal pumps have a capacity of 30000 gallons a minute and will require about a 150 horse power engine to operate them. A plant of this capacity will be plenty large enough to handle all the rainfall and seepage.

Estimate of Cost.

A dirty fire tube boiler set up and ready to run cost about $10.00 a horse power. Good stationary engines can be bought at about $12.00 a horse power and the cost of installation is between $1.00 and $2.00 a horse power so that the cost of the engine might be figured about $2000.00. The three pumps would cost about $1300.00 A fore pump house

could be built and pump connections made for 5000.00.

A statement of cost therefor would be as follows.

800000 cu. yds. levee	@ 12¢	$	96000.00
150000 " " main ditch	@ 8¢		12000.00
100000 " " lateral "	@ 11¢		11000.00
Pump. plant			9800.00
Total cost			128800.00

The yearly expense on the levee and ditches will be practically nothing. About 1.0 cts per horse power per hour is the cost under these condition for operating an engine of this type, or say for a period of 100 days $1500.00 for pumping.

Discussion of Economic Factors.

Present value of land. The present sale price of the land is between $5.00 and $20.00 an acre, the average being about $15.00. The land is practically worthless for agriculture

now its only use being the fish which are taken from the lakes. The fishing is carried on during the months of January and February, about 7 or 8 carloads a week are shipped out of Beardstown for the rest during these months, the lakes on this tract of land furnishing a large proportion of this amount. One lake of 200 acres in the Illinoy and Sawn bottom yields on an average of $5000.00 worth of fish per annum. Reclaiming will tend to increase rather than diminish the income from the fishing.

Cost per Acre of Improvements

The initial cost per acre for the levees, ditches and pumping outfit will be $14.31. Cost of clearing land of trees brush and so forth will be $6.00 an acre and about 2500 acres will require clearing which makes the actual cost per acre for clearing $1.66 The cutting

in Chiney and Sawo land around to $5.00 an acre and this will be taken as the cost in this case, about 4000 acres will require filling which makes the actual cost per acre $2.22. The total cost per acre will then be as follows:-

Dykes, Sluices, Pumpstations	$14.31
Clearing land	1.66
Filling	2.22
Total cost per acre.	$18.19

The value of the land after reclamation can be approximated by the value set on the land already reclaimed across the river, this land runs from $75.00 to $100.00 an acre at the present time.

The productiveness of the reclaimed land will equal any farming land in the county as it is always insured against drought and if tiled and drained properly no trouble will be experienced from water. The fishing in the lakes will not be injured by reclaiming but

improved

Legal Considerations

The method to be followed by the owners of the land which it is proposed to reclaim is to become incorporated in a Drainage District under the statute provided for that purpose, see the Illinois Revised Statutes 1891 page 578. This statute provides that when a majority of land owners who represent one third of the area of the land petition the court for the formation of a drainage district the court shall appoint three commissioners to investigate the proposition and report upon it to the court.

If the court approves the plans and reports of the commissioners a jury of twelve men is appointed who personally inspect the land and ascertain the benefits or damages sustained by the different parts and make out an assessment roll accordingly.

Conclusion.

From a consideration of the foregoing discussion and plan it is to be taken that the individual tract of land is exceptionally well located for reclaiming. The soil is good, the engineering simple and the yearly expense for pumping but about 25 cents per acre. The productiveness of the investment as a whole is established by the success attained under exactly similar conditions across the river and the proposition may be considered as a safe investment which will pay large dividends.

Notwithstanding the above facts however, the difficulty in carrying out the idea is that the present owners of the land have not sufficient money to reclaim the land themselves; and capitalists are unwilling as yet to advance money for much more than one half the present sale value of the land, and as

and so the land will probably
be in state quo until it be
bought by persons who believe
in its possibilities and have
money enough to develop them.

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